REMARKS

Applicants thank the Examiner for the very thorough consideration given the present application. Claims 1, 2, 4, 6-19, 25-30, 42, 43, and 45-58 are now present in this application, of which claims 1, 19, 47, and 53 are independent. By this amendment, claims 1, 19, 47, and 53 have been amended, and claims 53-58 have been added. Reconsideration of this application, as amended, is respectfully requested.

Request for Withdrawal of Finality of Office Action

During the personal interview with Examiner Heckert and Supervising Examiner Barr on June 24, 2009 it was agreed that the finality of the current Office Action would be withdrawn because dependent claim 42 was not rejected over prior art and also for other discrepancies in rejecting various dependent claims.

Examiner Interview

Applicants thank the Examiner and his Supervisor for the courtesies extended to Applicants' representatives during the personal interview that was conducted on June 24, 2009. An Examiner Interview Summary was made of record as Paper No. 20090624.

During the interview, in addition to the issues noted above, Applicants' representative discussed the obviousness rejection of the independent claims over DE 197 43 508 ("DE '508) in view of Nakamura.

Applicants' representatives requested clarification of whether the Examiner intended a wholesale incorporation of Nakamura or just a portion of Nakamura into DE '508. The Examiner responded that either was possible. That is, the steam generator of Nakamura could be added as a completely self-contained unit or could be used to replace the steam generator of DE '508.

In addition, Applicants' representatives presented arguments that the hypothetical combination would not be obvious for several reasons including that the hypothetical combination ignores the teachings of each reference as a whole, that DE '508 teaches away from the combination, and that the hypothetical combination would render DE '508 unsuitable for its intended purposes. The Examiner indicated that he believed that it would be "obvious to try" despite

these arguments. Further discussion of these issues are set forth in greater detail below in response to the rejections under 35 U.S.C. § 103(a).

Finally, Applicants proposed amending the independent claims to make it clear that the steam generator is not located in an air circulation path where air in the tub would be mixed with the steam in the steam generator. The exact opposite situation is disclosed by DE '508.

Rejections under 35 U.S.C. §103

Claims 1, 2, 6, 7, 16-19, 26-30, and 45-49 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over DE '508 in view of Nakamura; claims 4, 25, and 50 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over DE '508 in view of Nakamura and further in view of Chang; claims 8 and 9 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over DE '508 in view of Nakamura in view of Sloan and further in view of Wang; claim 10 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over DE '508 in view of Nakamura and further in view of Pick; claims 11 and 51 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over DE '508 in view of Nakamura and further in view of Aksenov; claims 12 and 52 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over DE '508 in view of Nakamura and further in view of Tsutsumi; and claims 13-15 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over DE '508 in view of Nakamura and further in view of Glucksman. These rejections are respectfully traversed.

Complete discussions of the Examiner's rejections are set forth in the Office Action, and are not being repeated here.

Because the rejection is based on 35 U.S.C. § 103, what is in issue in such a rejection is "the invention as a whole," not just a few features of the claimed invention. Under 35 U.S.C. § 103, " [a] patent may not be obtained . . . if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains." The determination under § 103 is whether the claimed invention as a whole would have been obvious to a person of ordinary skill in the art at the time the invention was made. *See* In re O'Farrell, 853 F.2d 894, 902, 7 USPQ2d 1673, 1680 (Fed. Cir.

1988). In determining obviousness, the invention must be considered as a whole and the claims must be considered in their entirety. *See* Medtronic, Inc. v. Cardiac Pacemakers, Inc., 721 F.2d 1563, 1567, 220 USPQ 97, 101 (Fed. Cir. 1983).

In rejecting claims under 35 U.S.C. § 103, it is incumbent on the Examiner to establish a factual basis to support the legal conclusion of obviousness. *See* In re Fine, 837 F.2d 1071, 1073, 5 USPQ2d 1596, 1598 (Fed. Cir. 1988). In so doing, the Examiner is expected to make the factual determinations set forth in Graham v. John Deere Co., 383 U.S. 1, 17, 148 USPQ 459, 467 (1966), and to provide a reason why one of ordinary skill in the pertinent art would have been led to modify the prior art or to combine prior art references to arrive at the claimed invention. Such reason must stem from some teaching, suggestion or implication in the prior art as a whole or knowledge generally available to one having ordinary skill in the art. Uniroyal Inc. v. F-Wiley Corp., 837 F.2d 1044, 1051, 5 USPQ2d 1434, 1438 (Fed. Cir. 1988), cert. denied, 488 U.S. 825 (1988); Ashland Oil, Inc. v. Delta Resins & Refractories, Inc., 776 F.2d 281, 293, 227 USPQ 657, 664 (Fed. Cir. 1985), cert. denied, 475 U.S. 1017 (1986); ACS Hospital Systems, Inc. v. Montefiore Hospital, 732 F.2d 1572, 1577, 221 USPQ 929, 933 (Fed. Cir. 1984). These showings by the Examiner are an essential part of complying with the burden of presenting a *prima facie* case of obviousness. *Note* In re Oetiker, 977 F.2d 1443, 1445, 24 USPQ2d 1443, 1444 (Fed. Cir. 1992). The mere fact that the prior art may be modified in the manner suggested by the Examiner does not make the modification obvious unless the prior art suggested the desirability of the modification. In re Fritch, 972 F.2d 1260, 1266, 23 USPQ2d 1780, 1783-84 (Fed. Cir. 1992). To establish *prima facie* obviousness of a claimed invention, all the claim limitations must be suggested or taught by the prior art. In re Royka, 490 F.2d 981, 180 USPQ 580 (CCPA 1970). All words in a claim must be considered in judging the patentability of that claim against the prior art. In re Wilson, 424 F.2d 1382, 1385, 165 USPQ 494, 496 (CCPA 1970).

A showing of a suggestion, teaching, or motivation to combine the prior art references is an "essential evidentiary component of an obviousness holding." C.R. Bard, Inc. v. M3 Sys. Inc., 157 F.3d 1340, 1352, 48 USPQ2d 1225, 1232 (Fed. Cir. 1998). This showing must be clear and particular, and broad conclusory statements about the teaching of multiple references, standing

alone, are not "evidence." *See* In re Dembiczak, 175 F.3d 994 at 1000, 50 USPQ2d 1614 at 1617 (Fed. Cir. 1999).

Moreover, it is well settled that the Office must provide objective evidence of the basis used in a prior art rejection. A factual inquiry whether to modify a reference must be based on objective evidence of record, not merely conclusory statements of the Examiner. *See* In re Lee, 277 F.3d 1338, 1343, 61 USPQ2d 1430, 1433 (Fed. Cir. 2002).

Furthermore, during patent examination, the PTO bears the initial burden of presenting a *prima facie* case of unpatentability. In re Oetiker, 977 F.2d 1443, 1445, 24 USPQ2d 1443, 1444 (Fed. Cir. 1992); In re Piasecki, 745 F.2d 1468, 1472, 223 USPQ 785, 788 (Fed. Cir. 1984). If the PTO fails to meet this burden, then the applicant is entitled to the patent. Only when a *prima facie* case is made, does the burden shift to the applicant to come forward to rebut such a case.

With these requirements in mind, Applicants provide additional comments regarding the arguments presented during the personal interview discussed above.

Hypothetical Combination of DE '508 and Nakamura Ignores the Teaching of Each Reference as a Whole

Applicants have attached a translation of DE '508 to further clarify the teachings of DE '508. As described in DE '508, many conventional washing machines rely on heating wash water using a heating element in a tub or via a recirculating pump system that has a continuous flow heater therein. With both of these approaches, the wash water is in direct contact with the heater, often resulting in calcium deposits on the heating element or corroding of the heating element over time. Furthermore, systems that use heaters in the tubs necessarily require greater amounts of water because of the additional space occupied by the heater. All of which decrease the efficiency of the conventional washing machine. See page 1 of DE '508.

Therefore, DE '508 provides a system in a combination washer/dryer that uses the existing duct work and heating element for drying laundry to provide a means for heating wash water without the wash water coming into contact with heating element. In particular, DE '508 discloses a combination washer/dryer having a tub 1, a drum 3, a drying air duct 13, a heating element 9, and a blowing fan 11. Water intakes 15 and 17 are provided before the heating element 9 and the blowing

fan 11, respectively. Because of this configuration, a heating medium (e.g. air/water mixture or air/steam mixture) passes by the heating element 9, is heated by the heating element 9, and subsequently contacts the wash water. See page 3 of DE '508.

By eliminating the heating element in direct contact with the wash water found in conventional washing machines, the operational lifespan of the heating element is increased. Furthermore, a decrease in the amount of water and detergent necessary for washing is achieved. At the same time, a decrease in the energy consumption of the washing machine is provided. See page 2 of DE '508.

In summary, to achieve these benefits, DE '508 discloses a system that utilizes an existing heating element in a drying duct of a combination washer/dryer to efficiently heat wash water without exposing the heating element to wash water.

In contrast, as discussed in previous responses, the steam generator of Nakamura is used to pre-treat stains on laundry prior to performing a wash cycle. The steam generator of Nakamura is a self-contained unit that operates independent of any washing cycles of a washing machine. Furthermore, Nakamura does not teach using the steam generator to heat wash water in the washing machine.

As such, DE '508 and Nakamura provide steam generators in different forms for different purposes. Therefore, one of ordinary skill in the art considering the references as a whole would not look to modify DE '508, which uses an existing heating element in a drying duct to heat wash water, to include a steam generator as taught by Nakamura, which uses steam to pre-treat stains on individual pieces of laundry prior to the laundry being subjected to a washing cycle. In particular, because DE '508 uses existing structure in the combination washer/dryer for multiple purposes, DE '508 is able to provide a simplified arrangement that reduces the amount of energy necessary to operate the combination washer/dryer.

Hypothetical Combination That Adds Steam Generator of Nakamura to Combined Washer/Dryer of DE '508 Goes Against Teaching of DE '508

Applicants respectfully submit that because DE '508 derives its advantages by using an existing heating structure in a drying duct to provide means of heating wash water in addition to

providing a drying function, modifying DE '508 in view of Nakamura would fundamentally alter the operation of DE '508 in a manner not intended by DE '508.

In particular, by using a single heater 9, DE '508 provides both drying of laundry and heating wash water. To add a second self-contained steam generator, as taught by Nakamura, would result in duplicate components without improving the operation of the combination washer/dryer of DE '508. Particularly, DE '508 states "if this method is used in a washer/dryer combination, a separate heating element for heating the wash water in addition to the heating element required for heating the drying air is not needed. This results in savings on structural parts, which entails a reduction in structural size and an increase in operational reliability due to a reduction in the number of structural parts." See page 6 of DE '508.

Hypothetical Combination That Replaces Steam Generator of DE '508 with Steam Generator of Nakamura Renders Impermissibly Alters Principle Operation of DE '508

According to M.P.E.P. § 2143.01 (VI), "[i]f the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims *prima facie* obvious." (Citation Omitted).

DE '508 makes repeated reference to the situation that the heating medium can be heated air passing through the drying duct 13, and, if necessary, moisture or steam can be added to the air. Therefore, circulating air in drying duct 13 is an indispensable operation of the combination washer/dryer of DE '508. If DE '508 were modified such that the steam generator of Nakamura was used in place of the heating element 9 and water intake 15, the combination would require the elimination of the drying duct 13 to allow for a water-supply tube to be connected between a water-supply valve assembly and the steam generator. However, such a modification would render the combination washer/dryer unsuitable for its intended purpose by altering the principle operation of the combination washer/dryer. Specifically, the purpose of providing a single heating element located in a manner to provide drying air and heating an air/water or air/steam mixture.

Office Action Fails to Set Forth Required Findings to Support "Obvious to Try"

With regard to "obvious to try" raised during the personal interview, Applicants note that M.P.E.P. § 2143(E) specifies that the Examiner must articulate:

> (1) a finding that at the time of the invention, there had been a recognized problem or need in the art, which may include a design need or market pressure to solve a problem;
>
> (2) a finding that there had been a finite number of identified, predictable potential solutions to the recognized need or problem;
>
> (3) a finding that one of ordinary skill in the art could have pursued the known potential solutions with a reasonable expectation of success; and
>
> (4) whatever additional findings based on the *Graham* factual inquiries may be necessary, in view of the facts of the case under consideration, to explain a conclusion of obviousness.

Moreover, "[i]f any of these findings cannot be made, then this rationale cannot be used to support a conclusion that the claim would have been obvious to one of ordinary skill in the art." The Office Action does not assert findings related to the standard set forth in M.P.E.P. § 2143(E), therefore, no further comments are necessary at this time.

For at least the foregoing reasons, Applicants submit that it would not have been obvious to modify DE '508 in view of Nakamura. None of the other references cited by the Examiner were relied on to overcome the above-noted deficiencies and, therefore, the § 103 rejections should not be maintained.

Amendments to the Claims

However, while not conceding the appropriateness of the Examiner's rejection, but merely to advance prosecution of the instant application, Applicants respectfully submit that independent claim 1 has been amended to recite a combination of elements in a steam drum washing machine including, *inter alia*, "a steam tube having one end connected to the steam generator and the other end in communication with the inside of at least one of the tub and the drum for downwardly supplying the steam into at least one of the tub and the drum, wherein air circulating in the tub is not combined with the steam in the steam tube while the steam is in the steam tube."

Similarly, while not conceding the appropriateness of the Examiner's rejection, but merely to advance prosecution of the instant application, Applicants respectfully submit that independent claim 19 has been amended to recite a combination of elements in a steam drum washing machine including, *inter alia*, "a steam tube having one end in communication with the steam generator and the other end in communication with the inside of at least one of the tub and the drum for downwardly supplying the steam into at least one of the tub and the drum" where "the steam in the steam tube is not combined with air from air circulating in the tub prior to the steam being delivered to at least one of the tub and the drum." Independent claim 47 has been similarly amended.

Applicants respectfully submit that this combinations of elements as set forth in independent claims 1, 19, and 47, as amended, are not disclosed or made obvious by the prior art of record, as discussed more fully during the Examiner Interview described above. In particular, DE '508 discloses that the heating medium is channeled via an inlet opening in the tub 1 and is discharged via an outlet opening in the tub, and that both the inlet and the outlet are located above the highest wash water level. See page 3 of DE '508. As a result, the heating medium is combined with air circulating in the tub 1 and both the air and the heating medium circulate through the drying duct 13 because DE '508 uses the existing heating element 9 in the drying duct 13 that also circulates drying air within the tub 1.

Accordingly, reconsideration and withdrawal of these rejections are respectfully requested for at least this additional reason.

With regard to dependent claims 2, 4, 6-18, 25-30, 42, 43, 45, 46, and 48-52, Applicants submit that these claims depend, either directly or indirectly, from independent claim 1, 19, or 47, which are allowable for the reasons set forth above, and therefore these claims are allowable based on their dependence from claim 1, 19, or 47, as well as for their additionally recited subject matter. Reconsideration and allowance thereof are respectfully requested.

Claims 53-58

Claims 53-58 have been added for the Examiner's consideration.

Independent claim 53 recites a combination of elements in a steam drum washing machine including, *inter alia*, "a steam generator for heating the water to generate steam and supplying the generated steam into at least one of the tub and the drum, the steam generator including a heater, the steam generator being located between an outer side of the tub and an inner side of the casing," and "a water-supply unit that supplies the water into the tub and the steam generator." The water-supply unit includes "a steam tube having one end connected to the steam generator and the other end in communication with the inside of at least one of the tub and the drum for downwardly supplying the steam into at least one of the tub and the drum, wherein a portion of the heater is arranged to extend along an outer surface of the steam tube.

Applicants respectfully submit that this combination of elements as set forth in independent claim 53 is not disclosed or made obvious by the prior art of record.

With regard to dependent claims 54-58, Applicants submit that that these claims depend, either directly or indirectly, from independent claim 1, 19, 47, or 53, which are allowable for the reasons set forth above, and therefore these claims are allowable based on their dependence from claim 1, 19, 47, or 53, as well as for their additionally recited subject matter.

Consideration and allowance of claims 53-58 are respectfully requested.

CONCLUSION

All of the stated grounds of rejection have been properly traversed, accommodated, or rendered moot. Applicants therefore respectfully request that the Examiner reconsider all presently outstanding rejections and that they be withdrawn. It is believed that a full and complete response has been made to the outstanding Office Action, and as such, the present application is in condition for allowance.

If the Examiner believes, for any reason, that personal communication will expedite prosecution of this application, the Examiner is invited to telephone Chad D. Wells, Registration No. 50,875, at (703) 205-8000, in the Washington, D.C. area.

Prompt and favorable consideration of this Amendment is respectfully requested.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. §§ 1.16 or 1.17; particularly, extension of time fees.

Dated: July 24, 2009

Respectfully submitted,

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Attachment: Translation for DE '508

METHOD FOR HEATING THE WASH WATER IN A WASHING MACHINE

DESCRIPTION

The present invention relates to a method for heating the wash water in a washing machine, in particular in a washer/dryer combination, according to the preamble of claim 1.

In washing machines, and in washing machines that include a clothes dryer (so-called washer/dryer combinations), soapy wash water is usually used for washing, particularly laundry. To increase the cleaning power, the wash water is usually heated.

In conventional washing machines, the heating of the wash water is either done via a heating element in the tub or via a recirculating pump system in a continuous-flow heater. These conventional solutions have various disadvantages.

In both scenarios, the wash water is brought in direct contact with the heating element, or at least with predominantly metallic surfaces supporting a heating element. This results in calcium deposits on the heating element and/or the metallic surfaces and corrosion thereof, thus decreasing their functional efficiency and their economic life span/durability. Since, as a rule, the wash water includes detergents, it has an especially corrosive effect on the heating element or the metallic surfaces, in particular at higher temperatures.

Since in both cases, the wash water has to be brought in contact with the heating element or the metallic surfaces, there is the further disadvantage of the so-called "tote Flotte", or dead flow, that is, a volume of wash water that does not take part in the washing process but only washes around the heating element for the purpose of heat transmission. In the instance of a recirculating pump system with a continuous-flow heater, the dead flow is the volume of wash water retained in the recirculating pump system and continuous-flow heater. If a heating element arranged in the tub is used, there is a dead flow because the tub has to be of a larger size thus requiring a larger volume of wash water, since in addition to the objects to be washed, it also has to accommodate the heating element. In devices for washing laundry, the laundry is usually loaded into a rotatable drum, which is arranged in the tub and is permeated by

the wash water. In this way, a dead flow is generated between drum and tub, which increases if in addition, the heating element is arranged between drum and tub. As a result of the dead flow, which is always present in the conventional methods for heating the wash water, the consumption of detergent, water and energy increases, thus prolonging the length of the washing cycle due to the larger volume of wash water to be heated.

It is therefore the object of the present invention to provide a method for heating the wash water, which reduces the dead flow, and/or danger of corrosion and calcium deposits on the heating element, and/or the length of the washing cycle.

The solution is found in the features of claim 1.

The method for heating the wash water in a washing machine, which is at least partially loaded with laundry, in particular a washer/dryer combination, with at least one heating element, according to the invention is characterized in that a non-aggressive heating medium passes by at least one heating element, is heated by it, and is subsequently brought in contact with the wash water. In this way, by eliminating the heating element in the dead flow, direct contact between corrosive wash water and heating device is avoided, and in addition, the dead flow is reduced. The result thereof is a longer operational life span of the heating element and a decrease in detergent, water and energy consumption for the washing machine, or the washer/dryer combination. When the laundry is soaked with wash water, the area available for the heat transfer between heating medium and wash water is increased, thus increasing the heating effect. If the heating element in the dead flow is not eliminated, the length of the washing cycle decreases considerably at greatly increased heat output.

Beneficially, the heating medium is an air/water mixture or an air/steam mixture. By using air as a heating medium, if necessary together with water or steam, the energy consumption for heating the heating medium is kept low due to the low density and thermal capacity of air, and minimum corrosion of the heating element is ensured. Furthermore, steam has the advantage of releasing a particularly high amount of energy in the form of heat during condensation.

Beneficially, the laundry is hereby agitated in the washing machine, at least from time to time. This ensures that the laundry is always soaked with wash water, thus achieving an especially good heat transfer between heating medium and wash water. Additionally, it is avoided in this way that the inflowing hot heating medium locally overheats the laundry in the washing machine, thus causing damage to the laundry.

It is beneficial for the heating medium to be of a temperature of essentially more than 130° C and a relative air humidity of essentially more than 95° C. By using a high temperature, a quick heating of the wash water is achieved, thus avoiding, due to the high air humidity, a drying up of the objects in the washing machine that are soaked or wetted with wash water.

Beneficially, the at least one heating element is used for heating the heating medium as well as the air used for drying the laundry. In this particularly beneficial embodiment, the heating element already present in washer/dryer combinations for heating the drying air is also used for heating the wash water, thus eliminating the need for an additional separate heating element.

Beneficially, the heating medium is channeled via an inlet opening in a tub to the wash water contained therein, and is discharged via a discharge opening in the tub, whereby both openings are located above the highest wash water level. In this way, a penetration of the wash water into the ducts for guiding the heating medium is avoided. In a washer/dryer combination, the already present ducts for guiding the heating medium are also used for guiding the heating medium, thus eliminating the expenditure of an additional structural part.

Beneficially, the heating medium is blown through the wash water. Thus, an especially intimate contact between heating medium and wash water, and an especially good heat transfer is achieved.

Beneficially, the inlet opening and the discharge opening for the heating medium are arranged in the tub far apart from one another, so that the heating medium travels as long a distance as possible in the tub thus connecting with the wash water for a long time, and in this way, a good heat exchange between heating medium and wash water takes place.

Furthermore, the present invention relates to a washing machine, in particular a water/dryer combination, comprised of a container for accommodating the wash water and the laundry, and having at least one heating element, which heats the wash water in accordance with an embodiment of the method of the present invention. With such washing machines, lower detergent, water and energy consumption as well as less corrosion of the heating element can be achieved. Additionally, in washer/dryer combinations, the need for an additional heating device for heating the wash water is eliminated so that a smaller manufacturing size is achievable and/or the dead flow volume can be kept low.

Beneficially, in the washing machine of the present invention, particularly in a washer/dryer combination, the water for washing, rinsing and cooling is channeled to the tub via the same channel and the same opening as the heating medium. In this way, the number of inlets connected directly to the drum can be reduced. Especially, if the detergent is not added via a detergent dispensing unit with a separate feeder line to the tub, but instead is added directly to the laundry via a separate receptacle, the number of feeder lines, and thus possible leaking or defective areas, can be reduced to a minimum.

It is beneficial for the heating element to also heat the introduced water for washing and rinsing. In this way, a separate heating device is not needed.

Further details, features and benefits of the present invention can be found in the description therebelow of a preferred embodiment with reference to the drawing.

In the drawing, the sole figure illustrates the schematic construction of a washer/dryer combination for laundry for the implementation of an embodiment of the method of the present invention.

As shown in the figure, the laundry 5 to be washed and dried is located in a drum 3, which in turn is located in a tub 1. The tub 1 is at least partially filled with wash water 7, which contains cleansing substances. Down below on the tub 1, a drain line 21 is connected, in which a pump 19 for extracting the wash water 7 and the rinsing water at the end of the washing process. On the top, for adding the detergent, the tub 1 is provided with a dispensing unit 23 from which the detergent is washed into the tub 1,

together with clean water from the water intake 25. In addition, a drying air duct 13 is connected to the tub 1. Both ends of the drying air duct 13 terminate in the tub 1 above the highest level of wash water 7. The drying air duct 13 is provided with a blowing fan 11, which circulates the air in the drying air duct through the tub 1 and the drum 3 loaded with laundry 5. This drying air duct 13 is provided with a heating element 9 for heating the drying air, a water intake 15 in flow direction behind the blowing fan, and a water intake 17 in front of the blowing fan.

At the launch of the washing process, the detergent in the dispenser unit 23 is washed via the water intake 25 into the tub 1, and additional washing water is supplied by the water intake 15 and/or 17 via the drying air duct 13. The washing water introduced via drying air duct 13 can thereby already be heated by the heating element 9. After reaching the target volume of wash water 7 in the tub 1, the drum 3 containing the laundry 5 to be washed is set in rotational motion, whereupon the laundry 5 is being soaked with wash water 7. To heat the wash water 7, hot air is blown in by blowing fan 11 via the drying air duct 13 to be heated by heating element 9. In drum 3, the hot air washes around the laundry 5 in the wash water 7, thus heating both wash water and laundry. To keep the soaked laundry 5 from being dried out by the hot air, the air has an increased humidity. For this purpose, the circulating air can be further humidified by one of water intakes 15 or 17.

Once the washing process is completed, the wash water is extracted by pump 19 via the drain line 21, and the remaining wash water 7 in the laundry 5 is removed by rinsing with clean water. The water for rinsing can be supplied by one of water intake lines 15 or 17, and can be heated by heating element 9, if so desired. At the end of the washing and rinsing process, the rinsing water remaining in the laundry is commonly removed for the most part by spinning the drum 3.

Subsequently, the laundry 5 is dried by drying air, which is circulated in the duct 13 by blowing fan 11 and is heated by heating element 9.

Thus, the solution of the present invention provides a method for heating the wash water in a washing machine, in particular a washer/dryer combination, wherein the corrosive and calciferous wash water does not come in direct contact with the heating

element, and the dead flow of the wash water can be reduced to a minimum. As a result, the durability and the efficiency of the heating element is increased, and the consumption of water, detergent and energy is decreased.

In addition, if this method is used in a washer/dryer combination, a separate heating element for heating the wash water in addition to the heating element required for heating the drying air is not needed. This results in a savings on structural parts, which entails a reduction in structural size and an increase in operational reliability due to a reduction in the number of structural parts. By additionally mounting a heating element 27 in the space for the dead flow, however, the length of the washing cycle can be considerably reduced because the heat output is almost doubled.

The application of the method of the present invention in household appliances can be particularly beneficial because they require especially reliable operation without frequent maintenance service as a result of corrosion or calcium deposits.

The invention is not limited to the described exemplary embodiment.

Alternatively, the method of the present invention can generally be applied in washing machines or dish washers, in which wash water is heated, as in a dish washer, for example. Particularly, its application is especially beneficial in washing machines, in which a washing as well as a drying process takes place.

PATENT CLAIMS

1. A method for heating the wash water in a washing machine that is at least partially loaded with laundry, in particular in a washer/dryer combination, having at least one heating element, **characterized in that** a heating medium passes by the at least one heating element (9), is heated by it, and is subsequently brought into contact with the wash water (7).

2. The method according to claim 1, characterized in that the heading medium is air, an air/water mixture, or an air/steam mixture.

3. The method according to claim 1 or 2, characterized in that the laundry (5) in the washing machine at least occasionally agitated.

4. The method according to one of claims 1 or 3, characterized in that the heating medium has a temperature of essentially more than 130° C and a relative air humidity of essentially more than 95 %.

5. The method according to one of claims 1 to 4, characterized in that the at least one heating element (9) is used both for heating the heating medium as well as the air used for drying the laundry (5).

6. The method according to one of claims 1 to 5, characterized in that the heating medium is channeled via a feeder opening in a tub (1) to the wash water (7) contained therein, and is discharged via a discharge opening in the tub (1), wherein both openings are located above the maximum wash water level.

7. The method according to one of claims 1 to 5, characterized in that the heating medium is blown through the wash water (7).

8. The method according to claim 6 or 7, characterized in that the feeder opening and the discharge opening in the tub (1) are arranged at the furthest possible distance from one another.

9. A washing machine, in particular a washer/dryer combination, comprised of a tub for accommodating the wash water and the laundry, and at least one heating element, characterized in that the wash water (7) is heated in accordance with a method according to one of claims 1 to 8.

10. The washing machine, in particular a washer/dryer combination, according to claim 9, characterized in that washing water, rinsing water and cooling water are supplied to the tub (1) via the same channel and the same opening as the heating medium.

11. The washing machine, in particular a washer/dryer combination, according to claim 11, characterized in that the heating element (9) also heats the supplied washing and rinsing water.

12. The washing machine according to one of the previous claims, characterized in that in addition, a heating device (27) is provided in the space for the dead flow.

ABSTRACT OF THE DISCLOSURE

In the method for heating the wash water (7) in a washing machine that is at least partially loaded with laundry (5), in particular a washer/dryer combination with at least one heating element (9), a heating medium passes the heating element, is heated by it, and is subsequently brought in contact with the wash water. In this way, corrosion and calcification of the heating element (9) can be reduced, the volume of needed wash water (7) be decreased, and thus the water, detergent and energy consumption can be lowered. In the beneficial application of the method in a washer/dryer combination, air is used for a heating medium, and the heating element heats the wash water as well as the air used to dry the washed laundry. Therefore, if used in washer/dryer combinations, the expense of an additional heating element can be eliminated.

REFERENCE NUMERALS

1	Laugenbehälter - tub
2	-
3	Trommel - drum
4	-
5	Wäsche - laundry
6	-
7	Waschlauge - wash water
8	-
9	Heizelement - heating element
10	-
11	Gebläse – blowing fan
12	-
13	Trocknungsluftkanal – drying air duct
14	-
15	Wasserzuführung – water intake
16	-
17	Wasserzuführung - water intake
18	-
19	Pumpe - pump
20	-
21	Ablaufleitung – drain line
22	-
23	Einspülschale – detergent dispensing unit
24	-
25	Wasserzuführung - water intake
26	-
27	Heizeinrichtung – heating element/heating device

METHOD FOR HEATING THE WASH WATER IN A WASHING MACHINE

DESCRIPTION

The present invention relates to a method for heating the wash water in a washing machine, in particular in a washer/dryer combination, according to the preamble of claim 1.

In washing machines, and in washing machines that include a clothes dryer (so-called washer/dryer combinations), soapy wash water is usually used for washing, particularly laundry. To increase the cleaning power, the wash water is usually heated.

In conventional washing machines, the heating of the wash water is either done via a heating element in the tub or via a recirculating pump system in a continuous-flow heater. These conventional solutions have various disadvantages.

In both scenarios, the wash water is brought in direct contact with the heating element, or at least with predominantly metallic surfaces supporting a heating element. This results in calcium deposits on the heating element and/or the metallic surfaces and corrosion thereof, thus decreasing their functional efficiency and their economic life span/durability. Since, as a rule, the wash water includes detergents, it has an especially corrosive effect on the heating element or the metallic surfaces, in particular at higher temperatures.

Since in both cases, the wash water has to be brought in contact with the heating element or the metallic surfaces, there is the further disadvantage of the so-called "tote Flotte", or dead flow, that is, a volume of wash water that does not take part in the washing process but only washes around the heating element for the purpose of heat transmission. In the instance of a recirculating pump system with a continuous-flow heater, the dead flow is the volume of wash water retained in the recirculating pump system and continuous-flow heater. If a heating element arranged in the tub is used, there is a dead flow because the tub has to be of a larger size thus requiring a larger volume of wash water, since in addition to the objects to be washed, it also has to accommodate the heating element. In devices for washing laundry, the laundry is usually loaded into a rotatable drum, which is arranged in the tub and is permeated by

the wash water. In this way, a dead flow is generated between drum and tub, which increases if in addition, the heating element is arranged between drum and tub. As a result of the dead flow, which is always present in the conventional methods for heating the wash water, the consumption of detergent, water and energy increases, thus prolonging the length of the washing cycle due to the larger volume of wash water to be heated.

It is therefore the object of the present invention to provide a method for heating the wash water, which reduces the dead flow, and/or danger of corrosion and calcium deposits on the heating element, and/or the length of the washing cycle.

The solution is found in the features of claim 1.

The method for heating the wash water in a washing machine, which is at least partially loaded with laundry, in particular a washer/dryer combination, with at least one heating element, according to the invention is characterized in that a non-aggressive heating medium passes by at least one heating element, is heated by it, and is subsequently brought in contact with the wash water. In this way, by eliminating the heating element in the dead flow, direct contact between corrosive wash water and heating device is avoided, and in addition, the dead flow is reduced. The result thereof is a longer operational life span of the heating element and a decrease in detergent, water and energy consumption for the washing machine, or the washer/dryer combination. When the laundry is soaked with wash water, the area available for the heat transfer between heating medium and wash water is increased, thus increasing the heating effect. If the heating element in the dead flow is not eliminated, the length of the washing cycle decreases considerably at greatly increased heat output.

Beneficially, the heating medium is an air/water mixture or an air/steam mixture. By using air as a heating medium, if necessary together with water or steam, the energy consumption for heating the heating medium is kept low due to the low density and thermal capacity of air, and minimum corrosion of the heating element is ensured. Furthermore, steam has the advantage of releasing a particularly high amount of energy in the form of heat during condensation.

Beneficially, the laundry is hereby agitated in the washing machine, at least from time to time. This ensures that the laundry is always soaked with wash water, thus achieving an especially good heat transfer between heating medium and wash water. Additionally, it is avoided in this way that the inflowing hot heating medium locally overheats the laundry in the washing machine, thus causing damage to the laundry.

It is beneficial for the heating medium to be of a temperature of essentially more than 130° C and a relative air humidity of essentially more than 95° C. By using a high temperature, a quick heating of the wash water is achieved, thus avoiding, due to the high air humidity, a drying up of the objects in the washing machine that are soaked or wetted with wash water.

Beneficially, the at least one heating element is used for heating the heating medium as well as the air used for drying the laundry. In this particularly beneficial embodiment, the heating element already present in washer/dryer combinations for heating the drying air is also used for heating the wash water, thus eliminating the need for an additional separate heating element.

Beneficially, the heating medium is channeled via an inlet opening in a tub to the wash water contained therein, and is discharged via a discharge opening in the tub, whereby both openings are located above the highest wash water level. In this way, a penetration of the wash water into the ducts for guiding the heating medium is avoided. In a washer/dryer combination, the already present ducts for guiding the heating medium are also used for guiding the heating medium, thus eliminating the expenditure of an additional structural part.

Beneficially, the heating medium is blown through the wash water. Thus, an especially intimate contact between heating medium and wash water, and an especially good heat transfer is achieved.

Beneficially, the inlet opening and the discharge opening for the heating medium are arranged in the tub far apart from one another, so that the heating medium travels as long a distance as possible in the tub thus connecting with the wash water for a long time, and in this way, a good heat exchange between heating medium and wash water takes place.

Furthermore, the present invention relates to a washing machine, in particular a water/dryer combination, comprised of a container for accommodating the wash water and the laundry, and having at least one heating element, which heats the wash water in accordance with an embodiment of the method of the present invention. With such washing machines, lower detergent, water and energy consumption as well as less corrosion of the heating element can be achieved. Additionally, in washer/dryer combinations, the need for an additional heating device for heating the wash water is eliminated so that a smaller manufacturing size is achievable and/or the dead flow volume can be kept low.

Beneficially, in the washing machine of the present invention, particularly in a washer/dryer combination, the water for washing, rinsing and cooling is channeled to the tub via the same channel and the same opening as the heating medium. In this way, the number of inlets connected directly to the drum can be reduced. Especially, if the detergent is not added via a detergent dispensing unit with a separate feeder line to the tub, but instead is added directly to the laundry via a separate receptacle, the number of feeder lines, and thus possible leaking or defective areas, can be reduced to a minimum.

It is beneficial for the heating element to also heat the introduced water for washing and rinsing. In this way, a separate heating device is not needed.

Further details, features and benefits of the present invention can be found in the description therebelow of a preferred embodiment with reference to the drawing.

In the drawing, the sole figure illustrates the schematic construction of a washer/dryer combination for laundry for the implementation of an embodiment of the method of the present invention.

As shown in the figure, the laundry 5 to be washed and dried is located in a drum 3, which in turn is located in a tub 1. The tub 1 is at least partially filled with wash water 7, which contains cleansing substances. Down below on the tub 1, a drain line 21 is connected, in which a pump 19 for extracting the wash water 7 and the rinsing water at the end of the washing process. On the top, for adding the detergent, the tub 1 is provided with a dispensing unit 23 from which the detergent is washed into the tub 1,

together with clean water from the water intake 25. In addition, a drying air duct 13 is connected to the tub 1. Both ends of the drying air duct 13 terminate in the tub 1 above the highest level of wash water 7. The drying air duct 13 is provided with a blowing fan 11, which circulates the air in the drying air duct through the tub 1 and the drum 3 loaded with laundry 5. This drying air duct 13 is provided with a heating element 9 for heating the drying air, a water intake 15 in flow direction behind the blowing fan, and a water intake 17 in front of the blowing fan.

At the launch of the washing process, the detergent in the dispenser unit 23 is washed via the water intake 25 into the tub 1, and additional washing water is supplied by the water intake 15 and/or 17 via the drying air duct 13. The washing water introduced via drying air duct 13 can thereby already be heated by the heating element 9. After reaching the target volume of wash water 7 in the tub 1, the drum 3 containing the laundry 5 to be washed is set in rotational motion, whereupon the laundry 5 is being soaked with wash water 7. To heat the wash water 7, hot air is blown in by blowing fan 11 via the drying air duct 13 to be heated by heating element 9. In drum 3, the hot air washes around the laundry 5 in the wash water 7, thus heating both wash water and laundry. To keep the soaked laundry 5 from being dried out by the hot air, the air has an increased humidity. For this purpose, the circulating air can be further humidified by one of water intakes 15 or 17.

Once the washing process is completed, the wash water is extracted by pump 19 via the drain line 21, and the remaining wash water 7 in the laundry 5 is removed by rinsing with clean water. The water for rinsing can be supplied by one of water intake lines 15 or 17, and can be heated by heating element 9, if so desired. At the end of the washing and rinsing process, the rinsing water remaining in the laundry is commonly removed for the most part by spinning the drum 3.

Subsequently, the laundry 5 is dried by drying air, which is circulated in the duct 13 by blowing fan 11 and is heated by heating element 9.

Thus, the solution of the present invention provides a method for heating the wash water in a washing machine, in particular a washer/dryer combination, wherein the corrosive and calciferous wash water does not come in direct contact with the heating

element, and the dead flow of the wash water can be reduced to a minimum. As a result, the durability and the efficiency of the heating element is increased, and the consumption of water, detergent and energy is decreased.

In addition, if this method is used in a washer/dryer combination, a separate heating element for heating the wash water in addition to the heating element required for heating the drying air is not needed. This results in a savings on structural parts, which entails a reduction in structural size and an increase in operational reliability due to a reduction in the number of structural parts. By additionally mounting a heating element 27 in the space for the dead flow, however, the length of the washing cycle can be considerably reduced because the heat output is almost doubled.

The application of the method of the present invention in household appliances can be particularly beneficial because they require especially reliable operation without frequent maintenance service as a result of corrosion or calcium deposits.

The invention is not limited to the described exemplary embodiment.

Alternatively, the method of the present invention can generally be applied in washing machines or dish washers, in which wash water is heated, as in a dish washer, for example. Particularly, its application is especially beneficial in washing machines, in which a washing as well as a drying process takes place.

PATENT CLAIMS

1. A method for heating the wash water in a washing machine that is at least partially loaded with laundry, in particular in a washer/dryer combination, having at least one heating element, **characterized in that** a heating medium passes by the at least one heating element (9), is heated by it, and is subsequently brought into contact with the wash water (7).

2. The method according to claim 1, characterized in that the heading medium is air, an air/water mixture, or an air/steam mixture.

3. The method according to claim 1 or 2, characterized in that the laundry (5) in the washing machine at least occasionally agitated.

4. The method according to one of claims 1 or 3, characterized in that the heating medium has a temperature of essentially more than 130° C and a relative air humidity of essentially more than 95 %.

5. The method according to one of claims 1 to 4, characterized in that the at least one heating element (9) is used both for heating the heating medium as well as the air used for drying the laundry (5).

6. The method according to one of claims 1 to 5, characterized in that the heating medium is channeled via a feeder opening in a tub (1) to the wash water (7) contained therein, and is discharged via a discharge opening in the tub (1), wherein both openings are located above the maximum wash water level.

7. The method according to one of claims 1 to 5, characterized in that the heating medium is blown through the wash water (7).

8. The method according to claim 6 or 7, characterized in that the feeder opening and the discharge opening in the tub (1) are arranged at the furthest possible distance from one another.

9. A washing machine, in particular a washer/dryer combination, comprised of a tub for accommodating the wash water and the laundry, and at least one heating element, characterized in that the wash water (7) is heated in accordance with a method according to one of claims 1 to 8.

10. The washing machine, in particular a washer/dryer combination, according to claim 9, characterized in that washing water, rinsing water and cooling water are supplied to the tub (1) via the same channel and the same opening as the heating medium.

11. The washing machine, in particular a washer/dryer combination, according to claim 11, characterized in that the heating element (9) also heats the supplied washing and rinsing water.

12. The washing machine according to one of the previous claims, characterized in that in addition, a heating device (27) is provided in the space for the dead flow.

ABSTRACT OF THE DISCLOSURE

In the method for heating the wash water (7) in a washing machine that is at least partially loaded with laundry (5), in particular a washer/dryer combination with at least one heating element (9), a heating medium passes the heating element, is heated by it, and is subsequently brought in contact with the wash water. In this way, corrosion and calcification of the heating element (9) can be reduced, the volume of needed wash water (7) be decreased, and thus the water, detergent and energy consumption can be lowered. In the beneficial application of the method in a washer/dryer combination, air is used for a heating medium, and the heating element heats the wash water as well as the air used to dry the washed laundry. Therefore, if used in washer/dryer combinations, the expense of an additional heating element can be eliminated.

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